

PCT

WORLD INTELLECTUAL PROPERTY ORGANIZATION
International Bureau



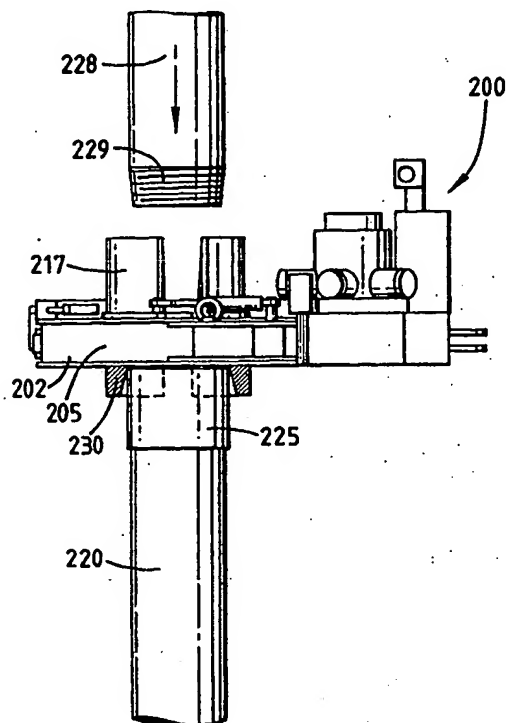
INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

<p>(51) International Patent Classification ⁶ : E21B 19/16</p>	<p>A1</p>	<p>(11) International Publication Number: WO 98/32948 (43) International Publication Date: 30 July 1998 (30.07.98)</p>
<p>(21) International Application Number: PCT/GB98/00282 (22) International Filing Date: 29 January 1998 (29.01.98) (30) Priority Data: 9701758.6 29 January 1997 (29.01.97) GB (71) Applicants (for all designated States except US): WEATHER-FORD/LAMB, INC. [US/US]; c/o CSC-The United States Corporation Company, 1013 Centre Road, Wilmington, DE 19805 (US). LUCAS, Brian, Ronald [GB/GB]; 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB). (72) Inventor; and (75) Inventor/Applicant (for US only): PIETRAS, Bernd-Georg [DE/DE]; Sandriedeweg 12, D-30900 Wedemark (DE). (74) Agent: LUCAS, Brian, Ronald; Lucas & Co., 135 Westhall Road, Warlingham, Surrey CR6 9HJ (GB).</p>		<p>(81) Designated States: AU, CA, CN, JP, NO, US, European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE). Published <i>With international search report.</i></p>

(54) Title: **APPARATUS AND METHOD FOR ALIGNING TUBULARS**

(57) Abstract

An apparatus for aligning tubulars comprises a guide (217) and a socket centralizer (230) which are mounted on opposite sides of a power tong (202). In use, the power tong (202) is lowered so that the socket centralizer (230) lies circumjacent the socket (215) of a lower length of casing (220) and an upper length of casing (228) is lowered so that its pin (229) is brought into alignment with the socket (225) by the guide (217). The power tong (202) is then raised and the jaw assemblies applied to grip the upper length of casing (228) which is then rotated to screw the pin (229) into the socket (225) and make up the joint to the required torque.



BEST AVAILABLE COPY

FOR THE PURPOSES OF INFORMATION ONLY

Codes used to identify States party to the PCT on the front pages of pamphlets publishing international applications under the PCT.

AL	Albania	ES	Spain	LS	Lesotho	SI	Slovenia
AM	Armenia	FI	Finland	LT	Lithuania	SK	Slovakia
AT	Austria	FR	France	LU	Luxembourg	SN	Senegal
AU	Australia	GA	Gabon	LV	Latvia	SZ	Swaziland
AZ	Azerbaijan	GB	United Kingdom	MC	Monaco	TD	Chad
BA	Bosnia and Herzegovina	GE	Georgia	MD	Republic of Moldova	TG	Togo
BB	Barbados	GH	Ghana	MG	Madagascar	TJ	Tajikistan
BE	Belgium	GN	Guinea	MK	The former Yugoslav Republic of Macedonia	TM	Turkmenistan
BF	Burkina Faso	GR	Greece	ML	Mali	TR	Turkey
BG	Bulgaria	HU	Hungary	MN	Mongolia	TT	Trinidad and Tobago
BJ	Benin	IE	Ireland	MR	Mauritania	UA	Ukraine
BR	Brazil	IL	Israel	MW	Malawi	UG	Uganda
BY	Belarus	IS	Iceland	MX	Mexico	US	United States of America
CA	Canada	IT	Italy	NE	Niger	UZ	Uzbekistan
CF	Central African Republic	JP	Japan	NL	Netherlands	VN	Viet Nam
CG	Congo	KE	Kenya	NO	Norway	YU	Yugoslavia
CH	Switzerland	KG	Kyrgyzstan	NZ	New Zealand	ZW	Zimbabwe
CI	Côte d'Ivoire	KP	Democratic People's Republic of Korea	PL	Poland		
CM	Cameroon	KR	Republic of Korea	PT	Portugal		
CN	China	KZ	Kazakhstan	RO	Romania		
CU	Cuba	LC	Saint Lucia	RU	Russian Federation		
CZ	Czech Republic	LJ	Liechtenstein	SD	Sudan		
DE	Germany	LK	Sri Lanka	SE	Sweden		
DK	Denmark	LR	Liberia	SG	Singapore		
EE	Estonia						

APPARATUS AND METHOD FOR ALIGNING TUBULARS

This invention relates to an apparatus and a method for aligning tubulars.

During the construction, maintenance and repair of oil and gas wells it is necessary to connect a large number of tubulars, for example lengths of drill pipe and casing. Conventionally the upper end of a tubular is provided with a threaded socket whilst the lower end is provided with a threaded pin which is slightly tapered.

In practice it is very easy for the pin of one tubular to be incorrectly inserted into the socket of an adjacent tubular with the result that the threads on one or both the pin and the socket can readily be damaged.

Considerable skill is required to correctly align tubulars and historically this task has been undertaken by a highly experienced rig-hand called a "stabber".

In order to facilitate correct alignment a device known as a "stabbing guide" is frequently used. One such stabbing guide comprises a plastic body member which can be mounted on the socket of a pipe held in slips. The plastic body member has a central passageway the upper part of which defines a funnel which leads into a lower passageway which is concentric with the socket. In use, as the upper tubular is lowered, its pin enters the funnel of the stabbing guide and then travels down the lower passageway into the socket. The stabbing guide (which comprises two semi-circular pieces hinged together around the socket) is then removed and the tubulars are screwed together and tightened to the required torque either by a power tong or a tong assembly comprising a power tong and a backup tong.

In order to simplify the stabbing operation the present invention provides an apparatus for aligning tubulars which apparatus comprises a guide mounted on

- 2 -

one of a power tong and a backup tong.

In one embodiment said apparatus further comprises a socket centralizer mounted on said one of said power tong and said backup tong.

5 Preferably, said one of said power tong and said backup tong is said power tong.

In another embodiment, said apparatus comprises a power tong and a backup tong, wherein said guide is mounted on said power tong and means are provided to
10 maintain said power tong and said backup tong in a certain juxtaposition during a stabbing operation.

Preferably, said means comprises locating rods on one of said power tong and said backup tong and blocks shaped to receive at least the ends of said locating
15 rods on the other of said power tong and said backup tong.

Advantageously, said backup tong is provided with at least two prismatic jaw assemblies to locate said backup tong in fixed juxtaposition with respect to a
20 tubular being gripped.

The present invention also provides methods for aligning tubulars as set out in Claims 7 and 8 hereto.

* * *

25

30

35

- 3 -

For a better understanding of the present invention reference will now be made, by way of example, to the accompanying drawings, in which:-

Figure 1a is a side elevation of a conventional
5 tong assembly;

Figure 1b is a top plan view of the tong assembly shown in Fig. 1a;

Figure 2a is a side elevation of a first embodiment of an apparatus in accordance with the present invention;
10

Figure 2b is a top plan view of the apparatus shown in Fig. 2a;

Figure 3a is a side view of the components of a guide forming part of the apparatus shown in Figs. 2a and 2b;
15

Figure 3b is a top plan view of the guide shown in Fig. 3a;

Figure 3c is a section on line IIIc-IIIc of Fig. 3b;

Figure 4 is a top plan view of the backup tong forming part of the apparatus shown in Figs. 2a and 2b with certain parts removed for clarity;
20

Figure 5 is a side elevation of the apparatus shown in Figs. 2a and 2b in a first position;

Figure 6 is a side elevation of the apparatus shown in Figs. 2a and 2b in a second position;
25

Figure 7 is a side elevation of the apparatus shown in Figs. 2a and 2b in a third position;

Figure 8 is a side elevation of the apparatus shown in Figs. 2a and 2b in a fourth position;
30

Figure 9 is a side elevation of the apparatus shown in Figs. 2a and 2b in a fifth position;

Figure 10 is a side elevation of a second embodiment of an apparatus in accordance with the present invention;
35

- 4 -

Figure 11 is a side elevation of a third embodiment of an apparatus in accordance with the present invention; and

Figure 12 is a perspective view of a fourth embodiment of an apparatus in accordance with the present invention.

Referring to Figures 1a and 1b of the drawings there is shown a conventional tong assembly which is generally identified by the reference numeral 1.

10 The tong assembly 1 comprises a power tong 2 and a backup tong 3.

The power tong 2 comprises a pair of gates 4, 5 which are held together in the position shown by latch 6. When the latch 6 is released the gates 4,5 can be swung open by admitting hydraulic fluid to piston and cylinder assemblies 7 and 8. The power tong 2 also contains a rotary 9 which is provided with four jaw assemblies 10. The rotary 9 can be rotated by a hydraulic motor 11.

20 The backup tong 3 is provided with two gates 12, 13 which are held together by latch 14 but which, when latch 14 is released can be swung to an open position.

In use, a lower length of casing (not shown), the upper end of which is provided with a socket, is gripped by slips. A stabbing guide is mounted on the socket and the pin of an upper length of casing is lowered into the stabbing guide.

Once the pin is correctly located the stabbing guide is removed. The gates 4,5 of the power tong 2 and the gates 12, 13 of the backup tong 3 are then opened and the tong assembly 1 moved towards the casing until the lower length of casing lies within the backup tong 3 and the upper length of casing lies within the power tong 2. The gates 4, 5, 12, 13 are then closed and latched. Jaw assemblies in the backup tong are then

- 5 -

advanced to engage the lower length of casing whilst jaw assemblies in the power tong 2 are advanced to grip the upper length of casing. The hydraulic motor 11 is then actuated to turn the rotary 9 and rotate the upper length of casing relative to the lower length of casing. The tong assembly 1 is supported by a pneumatic lifting cylinder 15 which enables the power tong 2 to move towards the backup tong 3 as the pin enters the socket. Reaction forces are transmitted by columns 16 disposed to either side of the tong assembly 1 and by a series of levers in a known manner. It should be noted that the power tong 2 is free to move in a plane parallel to the backup tong 3 within certain limits.

Referring now to Figures 2a and 2b there is shown an apparatus in accordance with the present invention which is generally identified by the reference numeral 100.

The apparatus 100 comprises a tong assembly 101 which is generally similar to the tong assembly 1 shown in Figs. 1a and 1b and parts of the tong assembly 101 similar to the tong assembly 1 have been identified by similar reference numerals in the "100" series.

The main differences are that:-

1. The top of the power tong 102 is provided with a guide 117;
2. The backup tong 103 is provided with jaw assemblies for accurately positioning the lower casing with respect to the backup tong 103; and
3. Means are provided for accurately aligning the power tong 102 with respect to the backup tong 103 and hence the guide 117 with the lower casing.

Turning firstly to the guide 117 it will be seen from Fig. 3 that this comprises four identical components 118 which are bolted to the top of the power tong 102. As best shown in Fig. 3c each component is tapered

- 6 -

so as to guide the pin of an upper casing to the centre of the opening of the power tong 102.

Referring now to Figure 4, the backup tong 103 is provided with three prismatic jaw assemblies 119a, 119b and 119c which, when actuated, hold a lower length of casing 120 in a fixed position relative to the backup tong 103.

As shown in Figure 5 the backup tong 3 is provided with three upwardly extending locating rods 121 which are each provided with a conical tip 122. Similar, the underside of the power tong 102 is provided with three blocks 123 each of which is provided with a recess 124 shaped to receive the conical tip 122 of a respective locating rod 121.

In use, the lower length of casing 120 is first secured by slips on the rig floor in the usual manner. The gates 112 and 113 of the backup tong 103 are then opened and the tong assembly 101 moved into position with the backup tong 103 circumjacent the lower length of casing 120 and immediately below the socket 125 thereof.

The gates 112 and 113 are then closed by hydraulic piston and cylinder assemblies 126 and 127 and the latch 114 closed. The prismatic jaw assembly 119a is fixed whilst prismatic jaw assemblies 119b and 119c are automatically advanced by a predetermined distance when the latch 114 is closed. This grips the lower length of casing firmly and also ensures that the backup tong 3 is in a fixed position relative to the lower length of casing 120. The position thusfar attained is shown in Fig. 5.

At this time pneumatic lifting cylinder 115 is extended which lowers the backup tong 3. The conical tips 122 of the locating rods 121 enter the recesses 124 of the blocks 123 and thus locate the power tong 2 with

- 7 -

respect to the backup tong 3. This in turn locates the guide 117 with respect to the lower length of casing 120 so that the centre of the guide 117 is coaxial with the axis of the lower length of casing 120. This position is shown in Fig. 6.

At this time the upper length of casing 128 is lowered into the proximity of the guide 117. As shown in Fig. 7 the lower end of the upper length of casing 128 is provided with a pin 129 which is tapered.

As the upper length of casing 128 is further lowered the pin 129 enters the guide 117 and is centred thereby. It then passes downwardly until it enters the socket 125 as shown in Fig. 8.

The power tong 102 is then raised so that the blocks 123 are well clear of the locating rods 121. At this point the jaw assemblies in the power tong 102 are applied to the upper length of casing 128 and the hydraulic motor 111 actuated to rotate the rotary and screw the pin 129 into the socket 125. During the procedure the power tong 102 moves towards the backup tong 103. However, even when the joint is tightened to the required torque the blocks 123 still lie a short distance above the conical tips 122 of the locating rods 121.

At this stage the jaw assemblies of both the power tong 102 and the backup tong 103 are relaxed, the gates 104, 105, 112 and 113 opened and the tong assembly 101 retracted in preparation for the casing being lowered. It will be noted that one component 118 of the guide 117 is mounted on each of the gates 104, 105 and accordingly the guide 117 opens and closes with the gates 104, 105.

For certain applications a backup tong is not required, for example where the power tong can conveniently be restrained by a chain attached to the drilling tower.

- 8 -

Figure 10 shows an apparatus in accordance with the present invention which is generally identified by the reference numeral 200.

5 The apparatus 200 comprises a power tong 202 which is generally similar to the power tong 2. The basic construction of the power tong 202 is similar to the power tong 2 and parts having similar functions have been identified by the same reference numeral in the "200" series.

10 The main differences are that the apparatus 200 does not include a backup tong and that it is provided with a guide 217 and a socket centraliser 230.

In use, the lower length of casing 220 is first secured by slips (not shown) with the socket 225 facing
15 upwardly close to the slips.

The power tong 202 is then lowered onto the socket 225 so that the socket 225 enters the socket centraliser 230 and aligns the socket centraliser 230, the socket 225 and the guide 217.

20 The upper length of casing 228 is then lowered so that its pin 229 enters the guide 217, is centred thereby and enters the socket 225. At this point power tong 202 is raised. Its jaw assemblies are then advanced to grip the upper length of casing 228 which is then rotated to screw the pin 229 into the socket 225.
25

Once the joint is tightened to the required torque the gates 204, 205 are opened and the power tong 202 withdrawn.

30

* * *

The embodiment shown in Fig. 11 is generally similar to that shown in Fig. 10 except that the apparatus 300 also includes a backup tong 303.

35

Since the upper length of casing 328 and the lower

length of casing 320 are being aligned by the guide 317 and the socket centraliser 330 no special arrangements need be made for aligning the power tong 302 and the backup tong 303.

- 5 The procedure for connecting the upper length of casing 328 to the lower length of casing 320 is as follows.

Firstly, the lower length of casing 320 is secured in slip (not shown).

- 10 The gates 312, 313 of the backup tong are then opened and the apparatus 300 manoeuvred so that the lower length of casing 320 is disposed within the backup tong 303.

- 15 The power tong 302 is then lowered until the socket 325 on the lower length of casing 320 is received within the socket centraliser 330.

- 20 The upper length of casing 328 is then lowered until the pin 329 passes through guide 317 and enters the socket 328. Only at this stage are gates 312, 313 closed and the jaw assemblies of the backup tong 303 activated to grip the lower length of casing 320.

- 25 The power tong 302 is then raised and its jaw assemblies activated to grip the upper length of casing 328 which is then rotated to cause the pin 329 to enter the socket 325 and the joint to be tightened to the desired torque.

The jaw assemblies are then relaxed and the gates 304, 305, 312, 313 of the power tong 302 and the backup tong 303 opened prior to retracting the apparatus 300.

- 30 Various modifications to the embodiments described are envisaged, for example, if desired, the guide and the socket centraliser could be mounted on the backup tong 303 rather than the power tong 302. Alternatively, the guide could be mounted on the backup tong without a
35 socket centraliser. Such an arrangement is shown in

Fig. 12.

* * *

5 The embodiment shown in Fig. 12 is generally similar to that shown in Fig. 1a and 1b and parts of the tong assembly 401 similar to the tong assembly 1 have been identified by similar reference numerals in the "400" series.

10 The main difference is that the top of the backup tong 403 is provided with a guide 417.

15 In use, the lower length of casing 420 is first secured by stops 431 on the rig floor in the usual manner. The gates 412 and 413 of the backup tong 403 are then opened. Since two of the four components 418 of the guide 417 are mounted on the gates 412 and 413 the guide 417 opens with the gates 412 and 413 so that the lower length of casing 420 can enter the backup tong 403 when the carriage 432 which supports the apparatus 400 is
20 advanced towards the casing 420 on rails 433.

25 When the lower length of casing 420 is fully within the backup tong 403 the gates 412 and 413 are closed. The components 418 of the guide 417 have a stepped interior (not visible in Figure 12) so that the lower part of each component 418 touches the socket on the top of the lower length of casing 420 whilst the upper part of the interior of each component 418 tapers inwardly to form a funnel. Once the lower length of casing 420 has been gripped the upper length of casing 428 is lowered
30 through the power tong 402 towards the lower length of casing 420. The guide 417 guides the pin on the bottom of the upper length of casing 428 into the socket. The power tong 402 is disposed a small distance above the guide 417. Once the pin of the upper length of casing
35 428 has entered the socket on the lower length of casing

- 11 -

the jaws of the power tong 402 are applied to the upper length of casing 428 which is rotated until the joint reaches the desired torque. Thereafter, gates 404, 405, 412, 413 are opened and the assembly 400 retracted on
5 the carriage 432.

10

15

20

25

30

35

- 12 -

Claims:-

1. An apparatus for aligning tubulars, which apparatus comprises a guide (117; 217; 317; 417) mounted on one of a power tong and a backup tong.
- 5 2. An apparatus as claimed in Claim 1, wherein said apparatus further comprises a socket centralizer (230; 330) mounted on said one of said power tong and said backup tong.
3. An apparatus as claimed in Claim 1 or 2, wherein
10 said one of said power tong and said backup tong is said power tong (102; 202; 302).
4. An apparatus as claimed in Claim 1, wherein said apparatus comprises a power tong (102) and a backup tong (103), wherein said guide (117) is mounted on said power
15 tong (102) and means (121, 123) are provided to maintain said power tong (102) and said backup tong (103) in a certain juxtaposition during a stabbing operation.
5. An apparatus as claimed in Claim 4, wherein said means (121, 123) comprises locating rods (121) on one of
20 said power tong (102) and said backup tong (103) and blocks (123) shaped to receive at least the ends of said locating rods (121) on the other of said power tong (102) and said backup tong (103).
6. An apparatus as claimed in Claim 4 or 5, wherein
25 said backup tong (103) is provided with at least two prismatic jaw assemblies (119) to locate said backup tong (103) in fixed juxtaposition with respect to a tubular being gripped.
7. A method for aligning tubulars, which method com-
30 prises the steps of aligning an upper tubular with a lower tubular with the use of the guide of an apparatus as claimed in Claim 3, raising said power tong, gripping said upper tubular and rotating said upper tubular to join said upper tubular to said lower tubular.
- 35 8. A method for aligning tubulars, which method

- 13 -

comprises the steps of gripping a lower tubular provided
with a socket with the backup tong of an apparatus as
claimed in Claim 4, moving said power tong relative to
said backup tong so that said means (121, 123) maintain
5 said power tong and said backup tong in said certain
juxtaposition, lowering an upper tubular having a pin
through said guide and allowing said pin to enter said
socket, raising said power tong, gripping said upper
tubular and rotating said upper tubular so that said pin
10 is screwed into said socket.

15

20

25

30

35

FIG. 1a

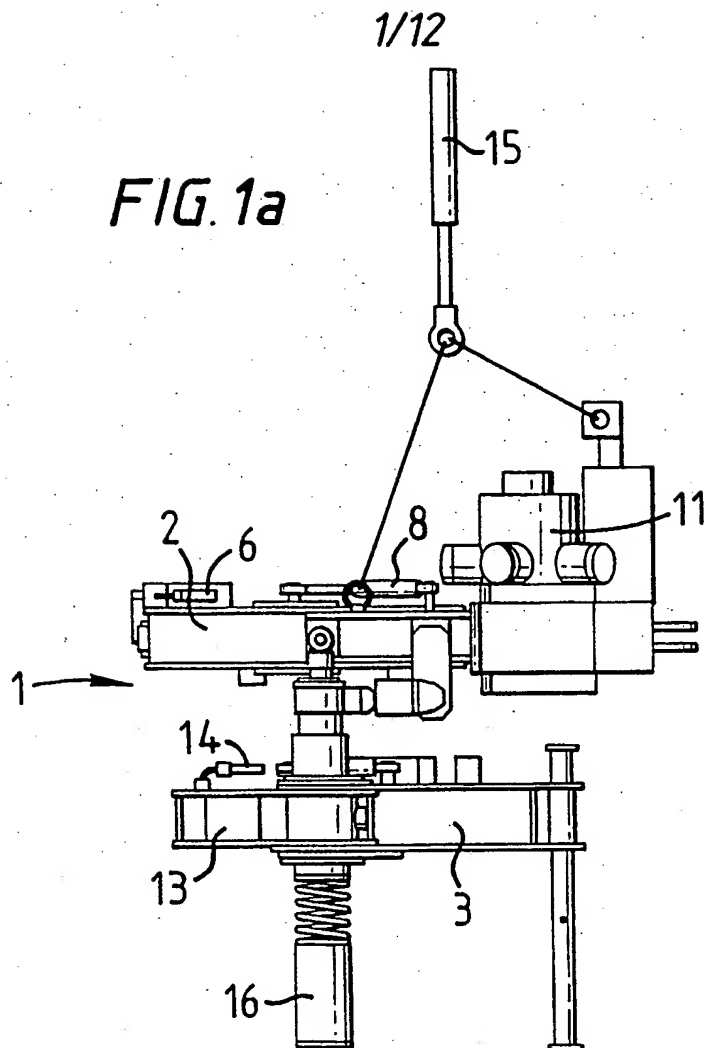


FIG. 1b

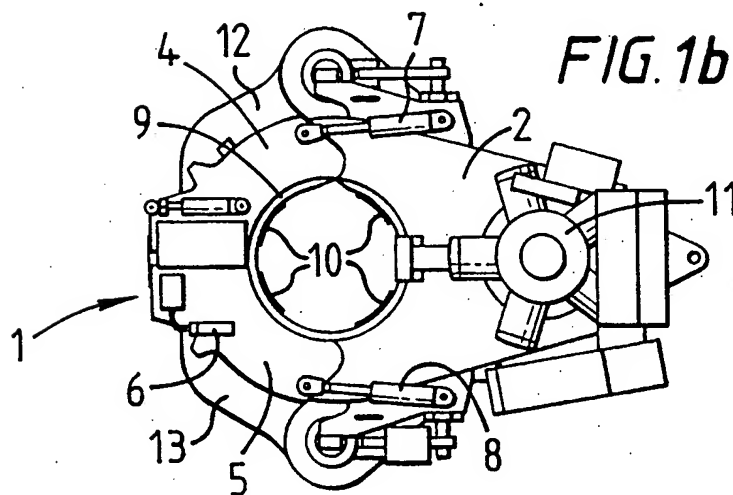


FIG. 2a

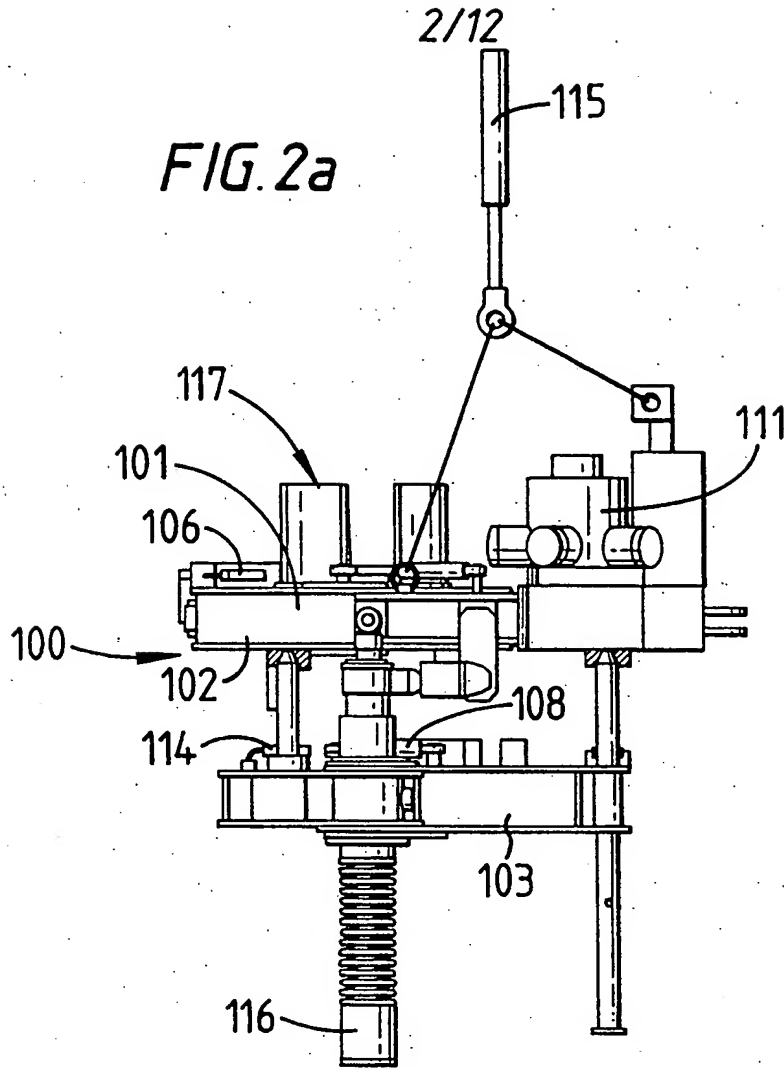
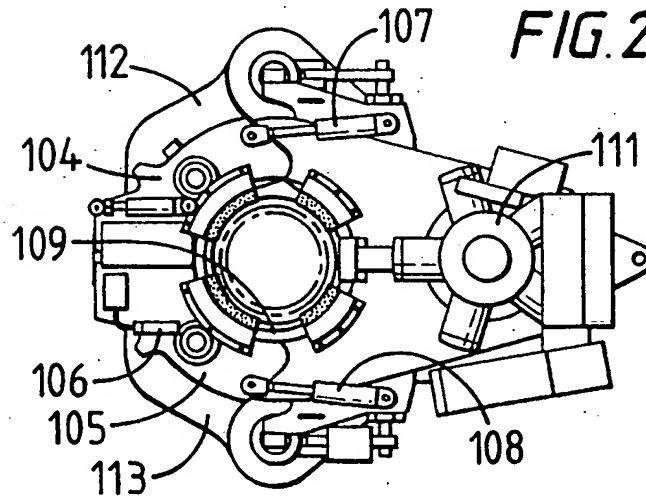


FIG. 2b



3/12

FIG. 3a

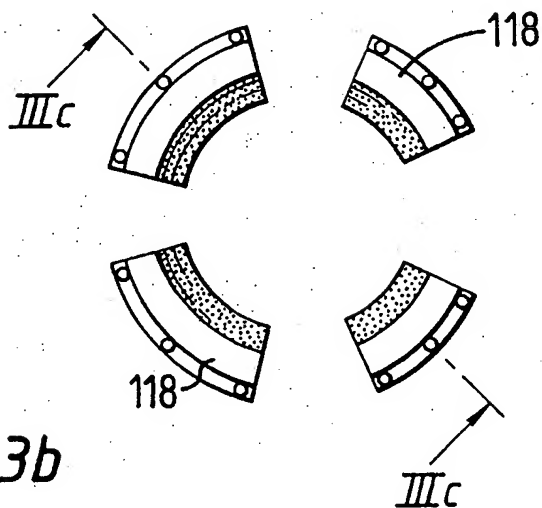
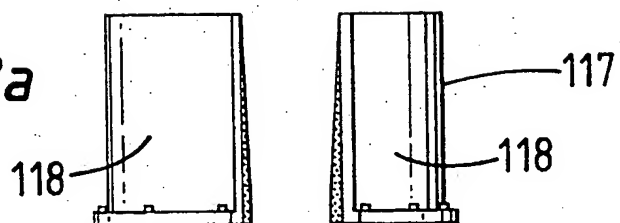
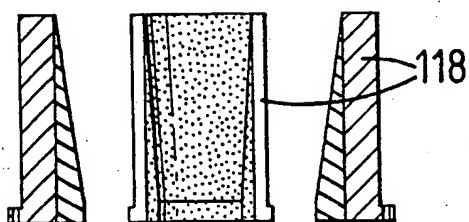


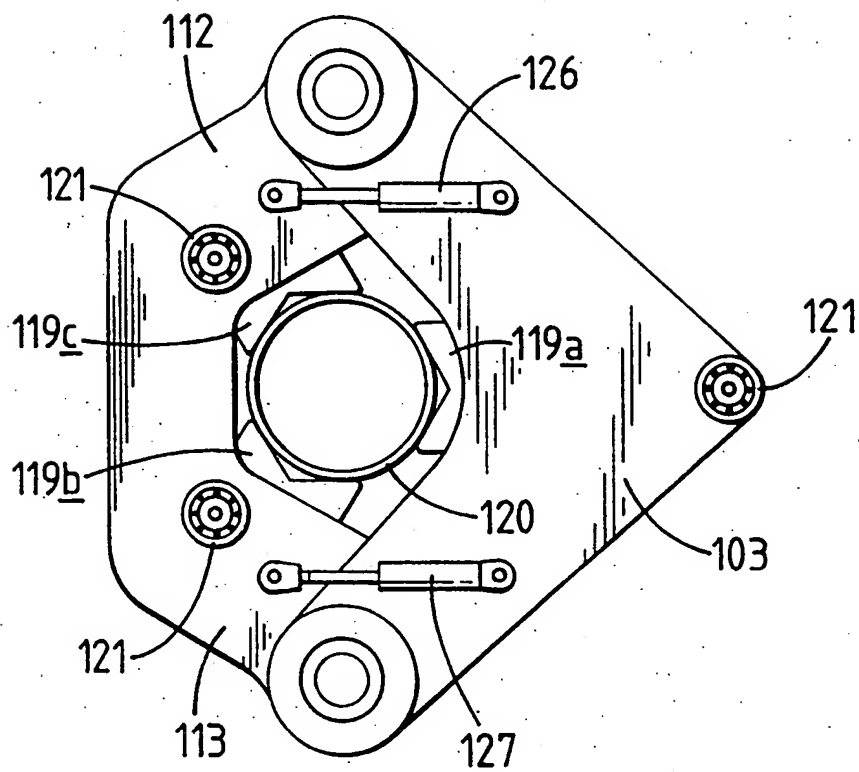
FIG. 3b

FIG. 3c

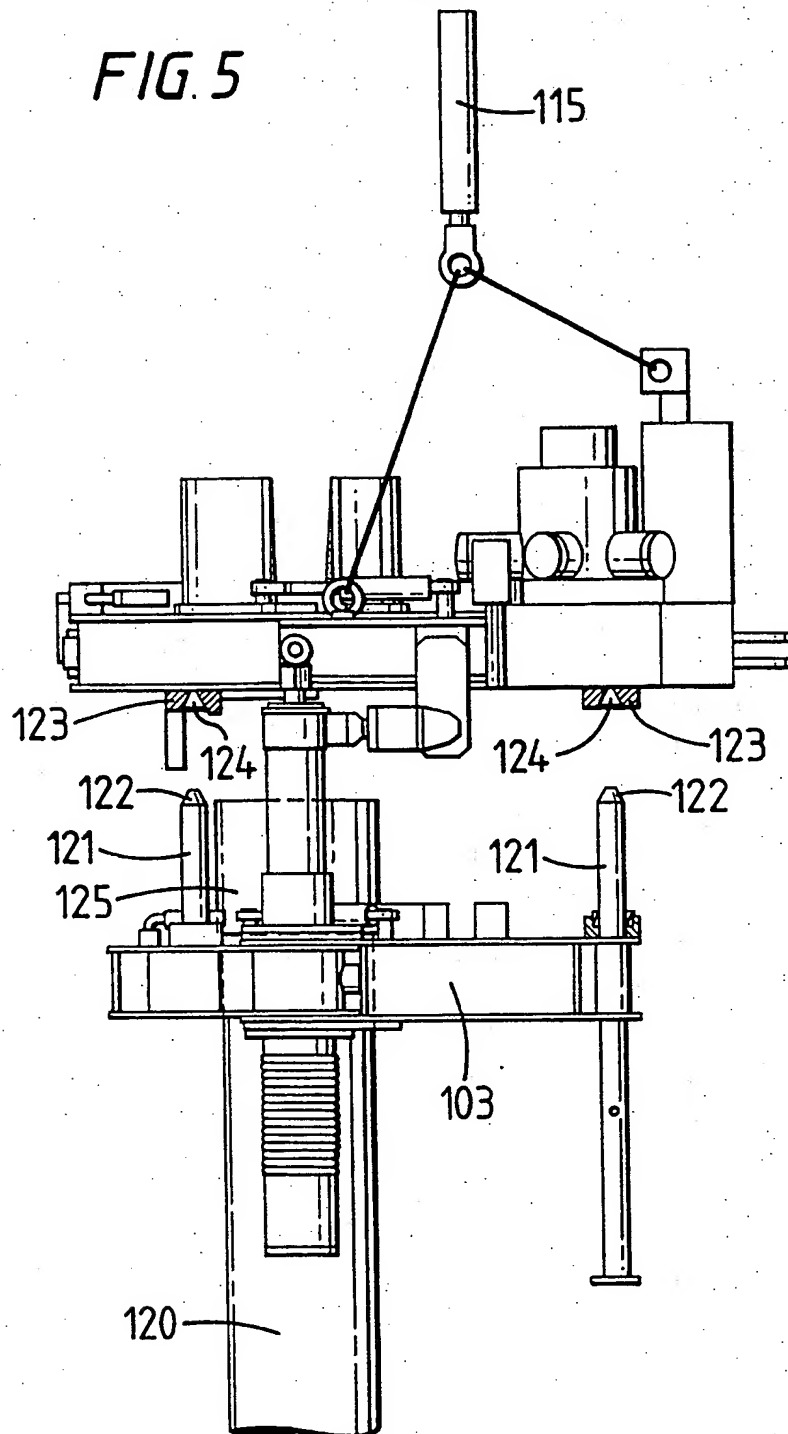


4/12

FIG. 4

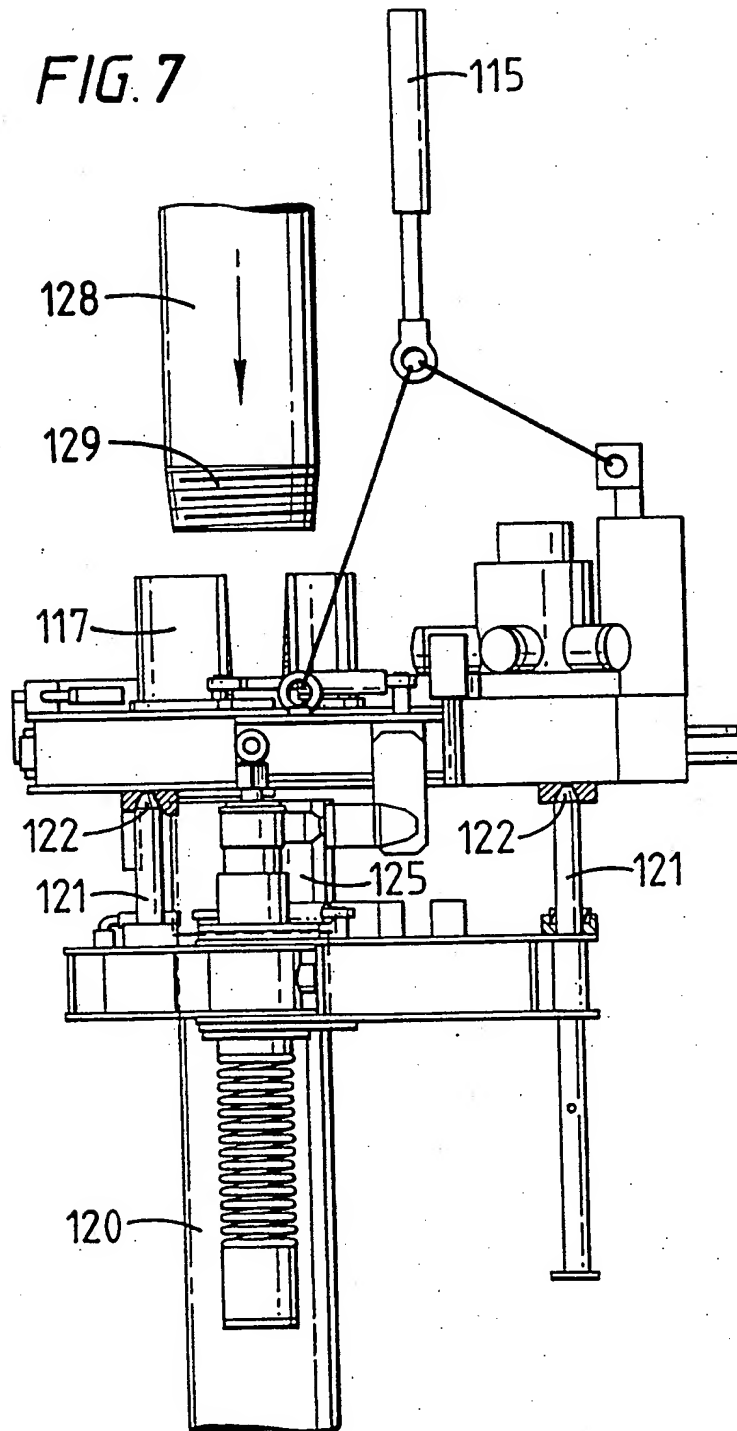


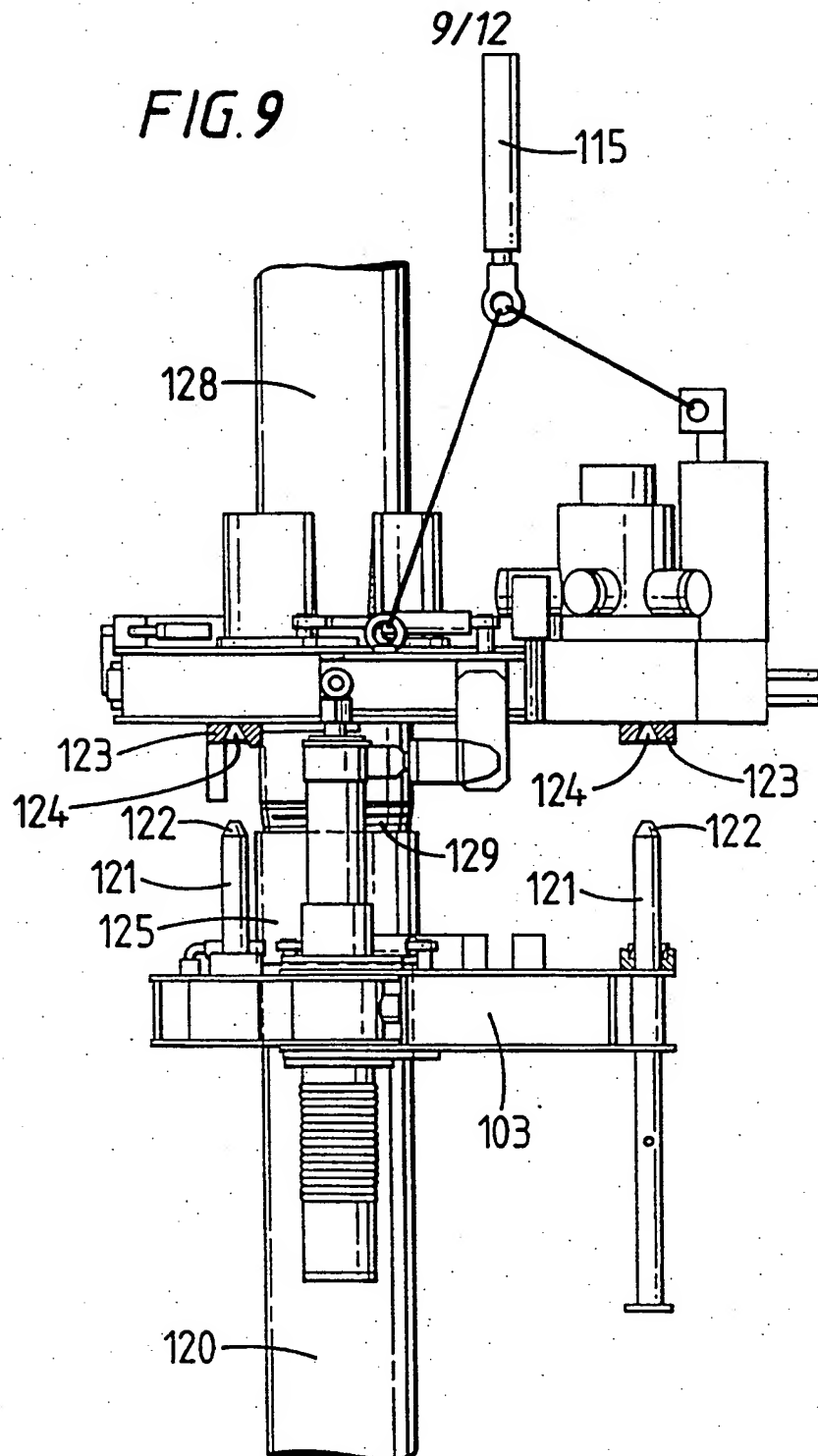
5/12
FIG. 5



7/12

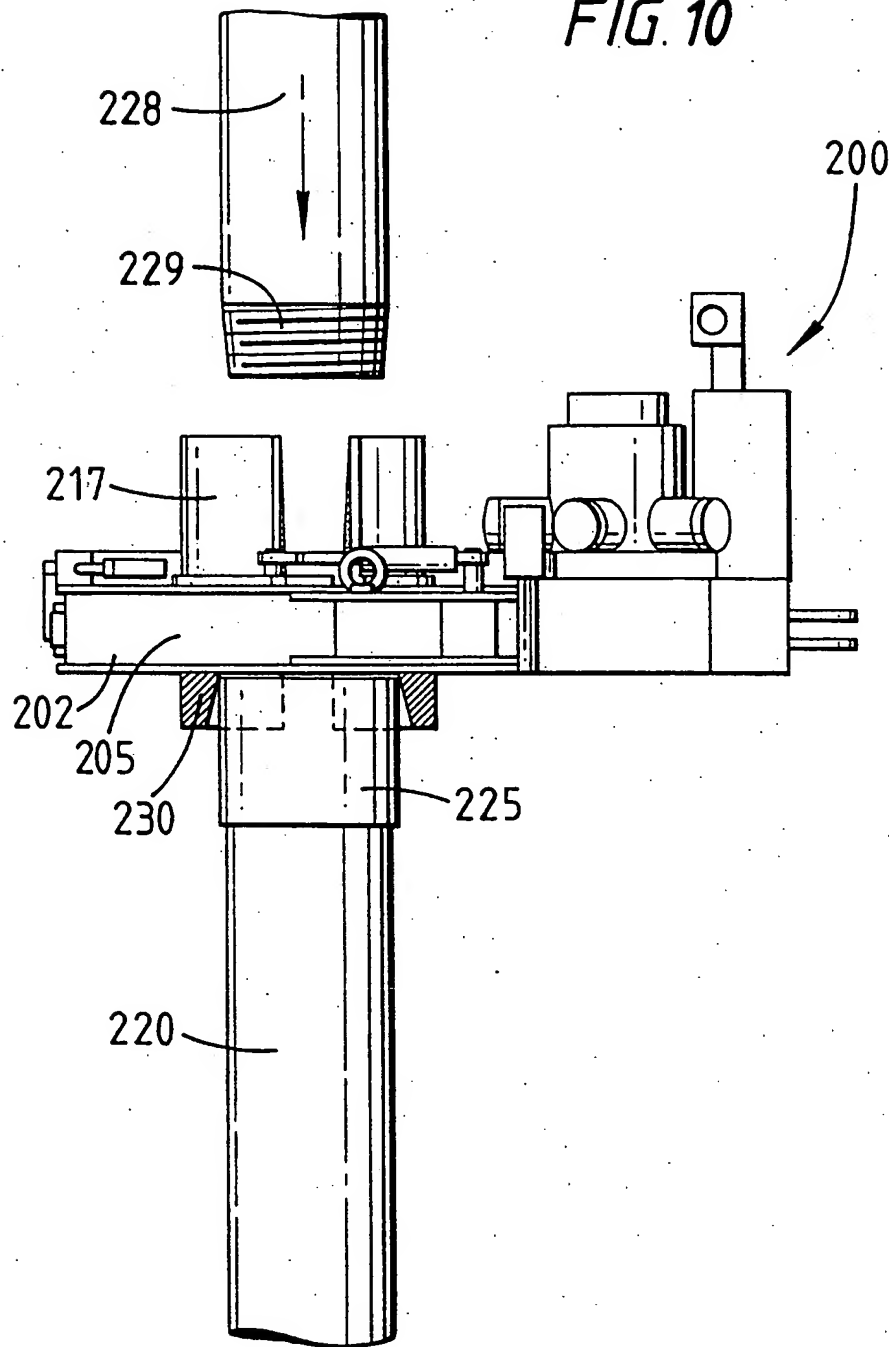
FIG. 7





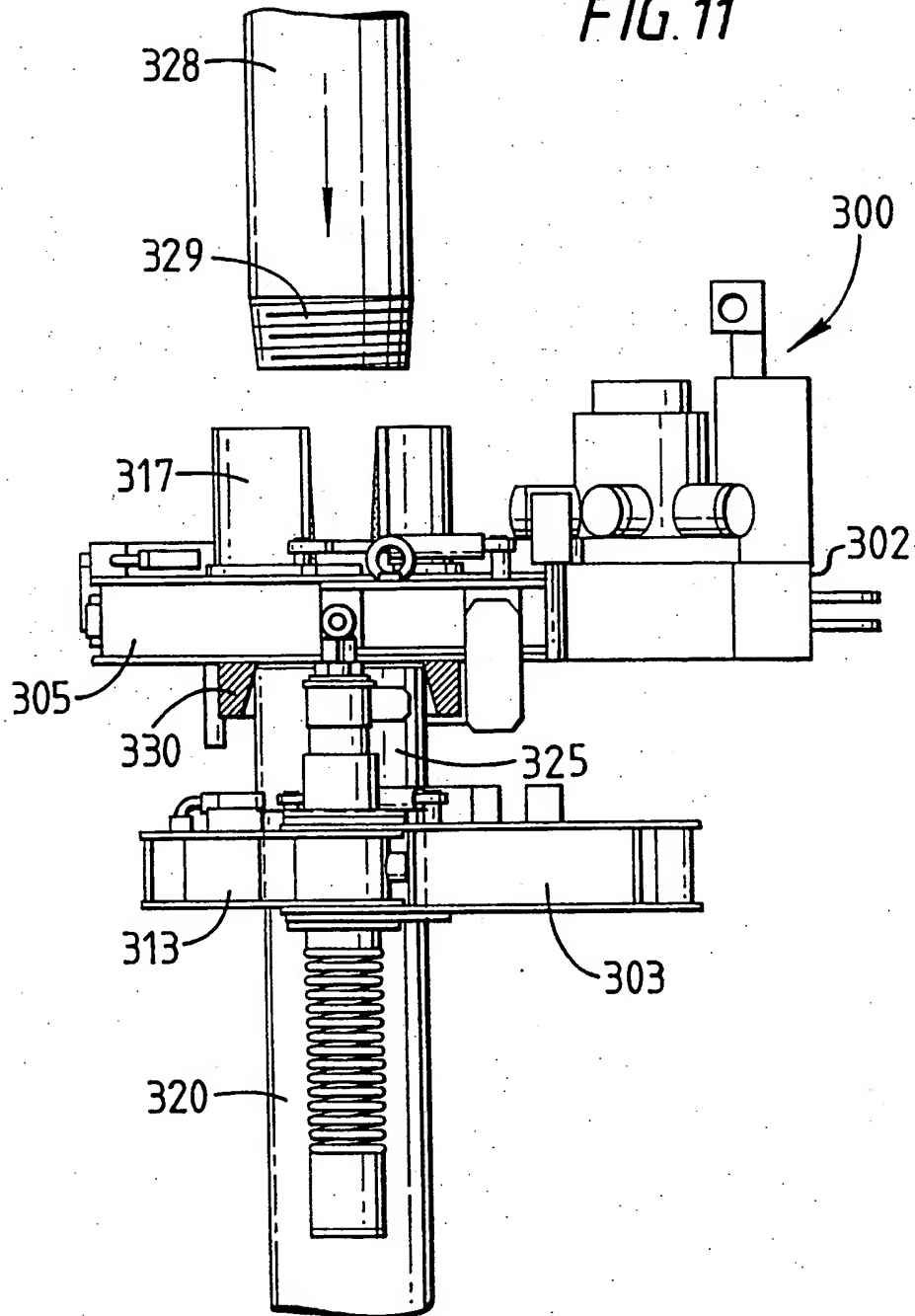
10/12

FIG. 10

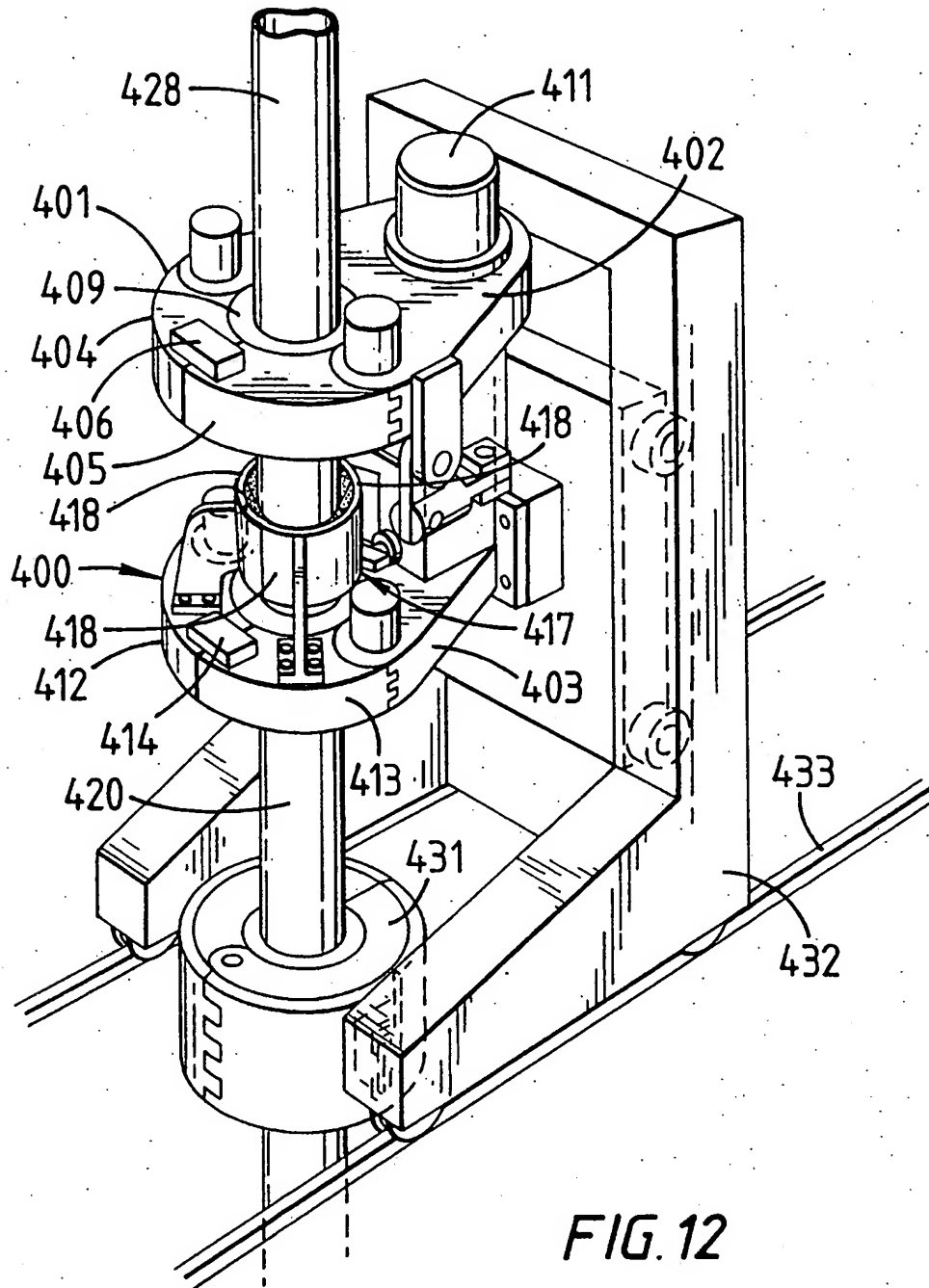


11/12

FIG. 11



12/12



INTERNATIONAL SEARCH REPORT

Inte. onal Application No

PCT/GB 98/00282

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6 E21B19/16

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6 E21B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	US 3 881 375 A (KELLY ROBERT R) 6 May 1975 see column 1, line 11 - line 22; figures 1,2	1,3,4 2,6
Y	US 4 599 778 A (DREYFUSS WILFRIED ET AL) 15 July 1986 see abstract; figures	2
X Y	US 3 635 105 A (DICKMANN JOHN L ET AL) 18 January 1972 see column 3, line 65 - column 4, line 7; figures 3-5	1,3 6
X	US 3 589 742 A (FLICK HOWARD S) 29 June 1971 see column 1, line 5 - line 11; figures 3,6 see column 3, line 6 - line 20; figure 3	1,3
-/--		

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier document but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.

"&" document member of the same patent family

Date of the actual completion of the international search

8 May 1998

Date of mailing of the international search report

15/05/1998

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Weiland, T

INTERNATIONAL SEARCH REPORT

Inter. Appl. No.
PCT/GB 98/00282

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	DE 12 45 288 B (DEMAG) 27 July 1967 see column 3, line 4 - line 8 see column 3, line 36 - line 38; figures ----	1,3
A	US 3 576 062 A (MATHERNE LEE J) 27 April 1971 see abstract; figures ----	1,7,8
A	US 4 213 237 A (WHITING WINSLOW) 22 July 1980 see abstract; figures ----	1
A	DE 35 37 471 C (DREYFUSS) 8 January 1987 see abstract; figures -----	1

INTERNATIONAL SEARCH REPORT

Information on patent family members

Inter. Application No

PCT/GB 98/00282

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3881375 A	06-05-1975	AT 333685 B AT 326592 B CA 984374 A CA 984910 A DE 2357603 A FR 2327386 A GB 1416245 A JP 49089604 A NL 7316566 A US 3882377 A	10-12-1976 29-12-1975 24-02-1976 02-03-1976 20-06-1974 06-05-1977 03-12-1975 27-08-1974 14-06-1974 06-05-1975
US 4599778 A	15-07-1986	DE 3315752 A DE 3331867 A EP 0124117 A CA 1266963 A JP 1746671 C JP 4034038 B JP 60060391 A	08-11-1984 21-03-1985 07-11-1984 27-03-1990 25-03-1993 04-06-1992 06-04-1985
US 3635105 A	18-01-1972	AT 291887 A DE 1783026 A FR 1589329 A GB 1226856 A GB 1226859 A GB 1226860 A US 3483774 A	15-07-1971 29-11-1973 23-03-1970 31-03-1971 31-03-1971 31-03-1971 16-12-1969
US 3589742 A	29-06-1971	AT 300696 A DE 2040241 A FR 2059040 A GB 1301560 A NL 7012243 A	15-07-1972 25-02-1971 28-05-1971 29-12-1972 23-02-1971
DE 1245288 B		NONE	
US 3576062 A	27-04-1971	NONE	
US 4213237 A	22-07-1980	NONE	
DE 3537471 C	08-01-1987	NONE	

**This Page is Inserted by IFW Indexing and Scanning
Operations and is not part of the Official Record**

BEST AVAILABLE IMAGES

Defective images within this document are accurate representations of the original documents submitted by the applicant.

Defects in the images include but are not limited to the items checked:

- ☐ **BLACK BORDERS**
- ☐ **IMAGE CUT OFF AT TOP, BOTTOM OR SIDES**
- ☐ **FADED TEXT OR DRAWING**
- ☐ **BLURRED OR ILLEGIBLE TEXT OR DRAWING**
- ☐ **SKEWED/SLANTED IMAGES**
- ☐ **COLOR OR BLACK AND WHITE PHOTOGRAPHS**
- ☐ **GRAY SCALE DOCUMENTS**
- ☐ **LINES OR MARKS ON ORIGINAL DOCUMENT**
- ☐ **REFERENCE(S) OR EXHIBIT(S) SUBMITTED ARE POOR QUALITY**
- ☐ **OTHER:** _____

IMAGES ARE BEST AVAILABLE COPY.

As rescanning these documents will not correct the image problems checked, please do not report these problems to the IFW Image Problem Mailbox.

THIS PAGE BLANK (USPTO)